

**PROCEDURES FOR THE CALIBRATION OF SOIL TEST
MOLDS
AASHTO T 99, T 134, T 180, T 193
AND UNIT WEIGHT MEASURES**

A. PURPOSE

This method provides instruction for the calibration of soil test molds and unit weight measures.

B. APPARATUS REQUIRED

Liquid Method

1. Calibrated balance capable of weighing the empty mold, water required to fill the mold and the plate glass
2. Plate glass 1/4 inch thick and at least one (1) inch larger than the diameter of the mold or measure
3. Wax Pot (for soil mold only)
4. Calibrated thermometer readable to 0.1 °F or 0.1 °C

Linear Measurement Method

1. Only Linear Measurement Method is applicable for calibration of compaction molds in accordance with Test Method T 193.
2. Calibrated Caliper capable of measuring inside height and inside diameter and with a range of 0-8 inches and readable to at least 0.001 inches
3. Verified spacer disk

C. PROCEDURE

Liquid Method

1. Determine and record the empty weight of measure or mold and plate glass in grams.

Note: For molds used for soil testing, a light coat of wax or other substance that prevents leaks should be applied around the base of the mold before weighing to prevent loss of water.

2. Fill measure or mold with water at room temperature and cover with plate glass in a way to eliminate air bubbles and excess water.

Note: Wipe excess water away before weighing.

3. Determine the weight of measure or mold with water and glass. Record weight in grams.
4. Determine the temperature of water to the nearest 0.1 °C or 0.1 °F and record.
5. Subtract weight of empty measure or mold and glass from total weight to determine the weight of water in the measure.
6. Determine unit weight of water at test temperature from chart given and record.

Calculations:

$$1. \text{ Wt. of Mold, Glass and Water in grams} - \text{Wt. of Mold and Glass in grams} = \text{Wt. of Water in grams}$$

$$2. \text{ Volume} = \frac{\text{Wt. of Water in grams}}{\text{Unit Wt. of Water at Specific Temperature in g/ft}^3}$$

$$3. \text{ Mold Factor} = \frac{1}{\text{Volume}}$$

$$4. \text{ Correction Factor Conversion} = \frac{\text{Mold Factor}}{453.6}$$

Linear Measurement Method

1. Measure the inside diameter of the mold to the nearest 0.001 inches with calibrated calipers 6 times evenly spaced around the top of the mold and 6 times evenly spaced around the bottom of the mold and record each measurement and average all 12 measurements and record the average inside diameter.
2. Measure the inside height of the mold to the nearest 0.001 inches with calibrated calipers 6 times evenly spaced around the mold and record each measurement and average all 6 measurements and record the average inside height.
3. For molds being used for testing in accordance with Test Method T 193: Measure the inside height of the mold with the spacer disk to the nearest 0.001 inches with calibrated calipers 6 times evenly spaced around the mold and record each measurement and average all 6 measurements and record the average inside height.

Calculations:

$$1. \text{ Volume} = \left[K * \frac{3.14159 * \text{Avg Height} * (\text{Avg Diameter})^2}{4} \right] \div 28317$$

$$\text{Volume With Spacer Disk} = \left[K * \frac{3.14159 * \text{Avg Height w/ Spacer Disk} * (\text{Avg Diameter})^2}{4} \right] \div 28317$$

K = 16.387 = Constant to convert measurements made in inches

28317 = Factor to convert volume to cubic feet

$$2. \text{ Mold Factor} = \frac{1}{\text{Volume}}$$

$$3. \text{ Correction Factor Conversion} = \frac{\text{Mold Factor}}{453.6}$$

D. TOLERANCE

Any unit weight measure or soil test mold whose critical dimensions specified in the application test method exceeds more than 1 1/2 times the allowable amount shall not be calibrated using these methods and should be replaced.

EQUIPMENT CALIBRATION RECORD

LIQUID METHOD

Calibrated By: _____	Date: _____
Equipment: <u>Soil Test Molds and Unit Weight Measures</u>	Location (Lab): _____
Identification No.: _____	Verification Frequency: <u>12 months</u>
Previous Verification Date: _____	Next Due Date: _____
Calibration Equipment Used: <u>Calibrated balance (capacity greater than the mold plus water), SN: _____</u>	
<u>Calibrated thermometer (graduated in increments of 1.0 °F or °C. and having a range that includes the</u>	
<u>temperature to be checked), SN: _____</u>	<u>Plate Glass Wax Pot, ID No. _____</u>
Calibration Procedure: <u>(In-house) OMR-CVP-7A</u>	
<u>Note: All calibration equipment meets the requirements of section B of OMR-CVP-7A</u>	

Dimensions of Measures, U.S. Customary System

Capacity Cubic ft.	Inside Diameter	Inside Height	Bottom	Minimum Thickness of Metal Wall	Band at top
1/30 cu. ft.	3.976-4.024 in.	4.577-4.592 in.	N/A	N/A	N/A
1/13.33 cu. ft.	5.961-6.039 in.	4.577-4.592 in.	N/A	N/A	N/A
1/8.73 cu. ft.	5.974-6.026 in.	6.982-7.018 in.	N/A	N/A	N/A
1/10 cu. ft.	5.9-6.1 in.	6.0-6.2 in.	0.20 in.	0.10 in.	.10
1/3 cu. ft.	7.9-8.1 in.	11.4-11.6 in.	0.20 in.	0.10 in.	.10
1/2 cu. ft.	9.9-10.1 in.	10.9-11.1 in.	0.20 in.	0.12 in.	.20
1.0 cu. ft.	13.9-14.1 in.	11.1-11.3 in.	0.20 in.	0.12 in.	.20

Inside diameter or measure or mold: _____ in.

Inside height of measure or mold: _____ in.

Bottom thickness of measure: _____ in.

Wall thickness of measure: _____ in.

Temp. F	g/ft ³		Temp. F	g/ft ³
56	28298.3		71	28256.4
57	28296.0		72	28252.5
58	28293.8		73	28248.8
59	28291.5		74	28245.2
60	28289.2		75	28241.6
61	28286.5		76	28237.5
62	28283.8		77	28233.4
63	28281.1		78	28229.3
64	28278.3		79	28225.3
65	28275.6		80	28221.2
66	28272.4		81	28216.6
67	28269.3		82	28212.1
68	28266.1		83	28207.6
69	28262.9		84	28203.0
70	28259.7		85	28198.5

MOLD OR MEASURE CALIBRATION

Scale Weights should be expressed to nearest 0.1g

Measure Weight:

Weight of measure or mold, glass and water A: _____

Weight of measure or mold and glass B: _____

Weight of water C: (A-B) _____

Temperature of water D: _____

Unit weight of water from chart for Temp E: _____

Test 1

A1. _____ g

B1. _____ g

C1. _____ g

D1. _____

E1. _____

Test 2

A2. _____ g

B2. _____ g

C2. _____ g

D2. _____

E2. _____

Volume F: = (C / E) Expressed to nearest .00001

F1. _____

F2. _____

Avg. Volume G: = (F1 + F2) / 2 Expressed to nearest .00001

G. _____

Mold Factor H: = (1 / Volume) Expressed to nearest .00001

H. _____

EQUIPMENT CALIBRATION RECORD

Correction Factor Conversion I: = H / 453.6 Expressed to nearest .00001 I. _____

LINEAR MEASUREMENT METHOD

Calibrated By: _____	Date: _____
Equipment: <u>Soil Test Molds and Unit Weight Measures</u>	Location (Lab): _____
Identification No.: _____	Verification Frequency: <u>12 months</u>
Previous Verification Date: _____	Next Due Date: _____
Calibration Equipment Used:	Calibrated calipers with range of 0-8 inches and readable to at least 0.001 SN: _____ Verified spacer disk SN: _____
Calibration Procedure: <u>(In-house) OMR-CVP-7A</u>	
Note: All calibration equipment meets the requirements of section B of OMR-CVP-7A	

Dimensions of Measures, U.S. Customary System

Capacity Cubic ft.	Inside Diameter	Inside Height	Bottom	Minimum Thickness of Metal Wall	Band at top
1/30 cu. ft.	3.976-4.024 in.	4.577-4.592 in.	N/A	N/A	N/A
1/13.33 cu. ft.	5.961-6.039 in.	4.577-4.592 in.	N/A	N/A	N/A
1/8.73 cu. ft.	5.974-6.026 in.	6.982-7.018 in.	N/A	N/A	N/A
1/10 cu. ft.	5.9-6.1 in.	6.0-6.2 in.	0.20 in.	0.10 in.	.10
1/3 cu. ft.	7.9-8.1 in.	11.4-11.6 in.	0.20 in.	0.10 in.	.10
½ cu. ft.	9.9-10.1 in.	10.9-11.1 in.	0.20 in.	0.12 in.	.20
1.0 cu. ft.	13.9-14.1 in.	11.1-11.3 in.	0.20 in.	0.12 in.	.20

MOLD OR MEASURE CALIBRATION

Top Inside Diameter Measurement to the nearest 0.001	Bottom Inside Diameter Measurement to the nearest 0.001
1. _____ inches	7. _____ inches
2. _____ inches	8. _____ inches
3. _____ inches	9. _____ inches
4. _____ inches	10. _____ inches
5. _____ inches	11. _____ inches
6. _____ inches	12. _____ inches
Average Inside Diameter of all 12 Measurement: A. _____ Expressed to the nearest 0.001 inches	

Inside Height Measurement to the nearest 0.001	Inside Height with Spacer Disk Measurement to the nearest 0.001
1. _____ inches	1. _____ inches
2. _____ inches	2. _____ inches
3. _____ inches	3. _____ inches
4. _____ inches	4. _____ inches
5. _____ inches	5. _____ inches
6. _____ inches	6. _____ inches
Average Inside Height of all 6 Measurements: B. _____ Expressed to the nearest 0.001 inches	Average Inside Height with Spacer Disk of all 6 Measurements: X. _____ Expressed to the nearest 0.001 inches

EQUIPMENT CALIBRATION RECORD

Volume C: $\left(K \times \frac{3.14159 \times B \times (A)^2}{4}\right) \div 28317$ C. _____ Expressed to the nearest 0.00001

Volume Y: $\left(K \times \frac{3.14159 \times B \times (X)^2}{4}\right) \div 28317$ Y. _____ Expressed to the nearest 0.00001

K = 16.387 = Constant to convert measurements made in inches 28317 = Factor to convert volume to inches

Mold Factor D: $\left(\frac{1}{Volume}\right)$ D. _____ Expressed to the nearest 0.000001

Correction Factor Conversion E: $\left(\frac{D}{453.6}\right)$ E. _____ Expressed to the nearest 0.000001